REMOVAL ACTION MEMORANDUM

Non Time-Critical Removal Action
At
Bretz Abandoned Mercury Mine

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February, 2014

BLM
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Table of Contents

i. Acronyms

ACM - asbestos-containing material
AHERA - Asbestos hazard Emergency Response Act
amsl – above mean sea level
ARAR – Applicable or Relevant and Appropriate Requirement
BLM – Bureau of Land Management
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
COPC – contaminants of potential concern
COPEC – Contaminants of Potential Environmental Concern
CTE – central tendency exposure
EE/CA – Engineering Evaluation/Cost Analysis
EPA – U.S. Environmental Protection Agency
ERBSC - ecological risk-based screening concentrations
HI – Hazard Index
ODEQ – Oregon Department of Environmental Quality
ODFW - Oregon Department of Fish and Wildlife
OPA – Ore Processing Area
OWDR - Oregon Water Resources Department
PA – Preliminary Assessment
RA – Removal Action
RCRA – Resource Conservation and Recovery Act
COC – primary contaminant of concern
NWI - National Wetland Inventory
PPE – probably point of entry
RAO - Removal Action Objective
RME – reasonable maximum exposure
SI – site inspection
TCLP – Toxicity Characteristic Leaching Procedure
TDL - target distance limit
TR – total recoverable
USEPA – U.S. Environmental Protection Agency

UNITS OF MEASURE
bcy – bank cubic yards
mg/kg – milligrams per kilogram
µg/L – micrograms per liter

I. Purpose

The purpose of this Action Memorandum is to document BLM's decision to proceed with the Non-Time Critical Removal Action described in the Engineering Evaluation/Cost Analysis (EE/CA) and the Data-Gap Analysis for Bretz Mine located in the southern portion of Malheur County, Oregon. This removal action will address remediation of contaminated soil, sediment, and equipment remaining from the historic mercury processing at the Bretz Mine. The remediation Site is localized within a 1.5-acre Ore Processing Area (OPA) (also known as the Site) of the larger 342-acre Bretz Mine site.

The project administrative record, including the EE/CA document and Data-Gap Analysis, is available from the following Vale BLM website:

http://www.blm.gov/or/districts/vale/plans/index.php

The selected Response Action will be executed following non-time-critical removal action processes described by:

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; 42USC 9604)
- National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40CFR Part 300)
- US Environmental Protection Agency's (EPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA;* OSWER 9360.0-31, August 1993.

II. Site Conditions and Background

a. Site Description

(The following highlights the site features. For a more detailed description, please see the Site Inspection (SI) located at the website shown above.)

The Bretz Mine is located in Malheur County, Oregon, approximately 10 miles northwest of McDermitt, Nevada (Figure 1). The area is on Public Land administered by the Bureau of Land Management (BLM). The Disaster Peak Road to the Site is gravel and maintained for vehicles. Roads at the Site are not maintained and in some areas require high clearance vehicles. The Bretz Mine workings are located in four sections:

- West ½ of Section (Sec) 3 Township (T) 41 South (S), Range (R) 41 East (E) of the Willamette Meridian (WM)
- East ½ of Sec 4, T41S, R41E of WM
- SE ¼ of SE ¼ of Section 33, T40S, R41E of WM
- SW ¼ of SW ¼ of Section 34, T40S, R41E of WM

The latitude for the OPA is 42º 2' 29" north (N), longitude 117º 54' 13" west (W). The elevation of the Site ranges from approximately 5,530 feet above mean sea level (amsl) to 5,200 amsl. The Site is drained by three ephemeral creeks: Little Cottonwood Creek flows south though the mine workings and two unnamed creeks flow southwest to the east of the main mine workings. The headwaters of all three ephemeral creeks lie at elevations well

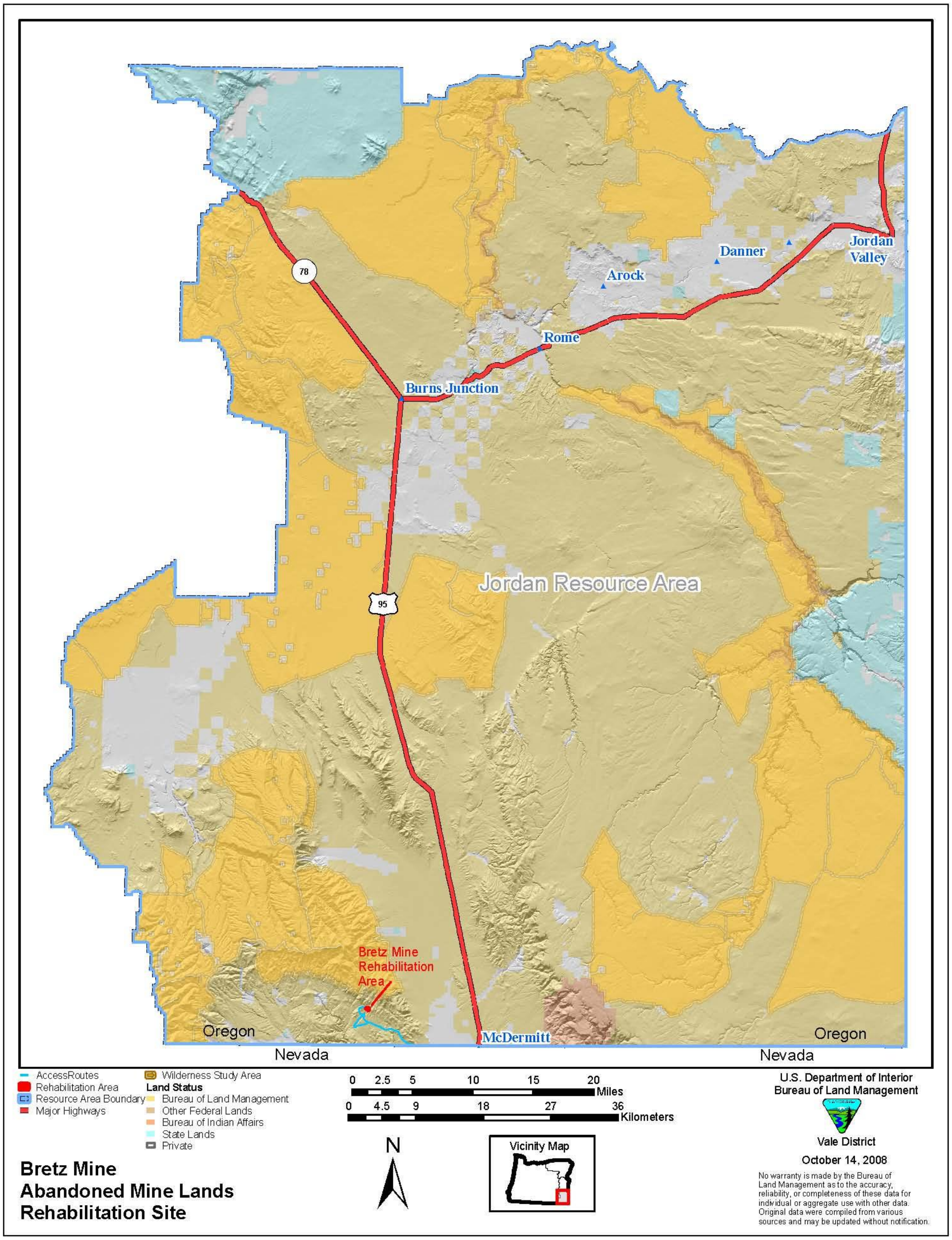

Figure 1: Bretz Mine Site Location

over 6,000 feet near the inside rim of the caldera. Land ownership at the Site consists of public lands administered by the BLM. The BLM has delegated CERCLA authority -to respond to the release or threatened release of hazardous substances where the release is on or the sole source of the release is from BLM-administered lands (E.O. 13016).

b. Site History

The Bretz Mine is an abandoned mercury mine located approximately 10 miles northwest of McDermitt, Nevada. The deposit was discovered in 1917 by William S. Bretz. Assessment work was done for many years before high grade mercury ore was discovered in 1931. The mine was then sold to the Bradley Mine Company, operator of the Opalite mercury mine, which is located approximately 6 miles west of the Bretz Mine (Schuette, 1938).

The mine is located on the northern margin of the McDermitt caldera complex, a series of nested, collapse-type calderas. Three mercury deposits are located along the rim of the caldera complex; the Ruja deposit, Cordero or McDermitt Mercury Mine in Nevada, and the Opalite and Bretz Mines in Oregon. The mine is geologically situated along the outer rim fault at the contact of a rhyolite welded tuff and inter-caldera lakebed sediments (Roper and Wallace, 1981).The caldera complex is also geochemically varied and is host to uranium and lithium mineralization.

The Bretz Mine was actively worked by the Bradley Mining Company from 1931 through 1936. All ore was shipped to the Opalite Mine for processing during this period. At the end of the 1936 mining season, the option to purchase the Bretz Mine was released and Bradley Mining apparently stopped work there (Schuette, 1938). Production values reported by Brooks (1971) indicate that further mining occurred after 1936. The total mercury production given by Brooks in 1971 was 15,185 flasks, and the last year of production recorded was 1968. A flask of mercury is equivalent to 76 pounds. The presence of processing equipment suggests that some processing may have occurred at the Site.

There are currently several active mining claims on and nearby the Site. BLM records indicate that the claimants are performing exploratory work for potential uranium mineralization and no recent mercury mining has occurred at the Site.

c. Removal Site Evaluation

The EE/CA, the Preliminary Assessment (PA) Oregon Department of Environmental Quality [ODEQ, 2001a]), the Bretz Mine Site Inspection Report (Weston, 2003), and Bretz Mine Investigation Summary Report (E&E, 2005), and the earlier associated studies indicate that concentrations of several hazardous substances, particularly mercury, are above screening levels in one or more media at the OPA and low-grade ore stockpile adjacent to the east of Little Cottonwood Creek. Furthermore, based on information provided in the Streamlined Risk Evaluation and Assessment section of the EE/CA, contaminants of potential concern at the Site include antimony, arsenic, cobalt, iron, thallium, vanadium, and zinc – with mercury being the primary contaminant of concern (COC).

The highest concentrations of mercury were exhibited in surface soils collected near the ore processor and mill foundation (up to 190,000 milligrams per kilogram [mg/kg]). The highest concentration of total mercury identified in the low-grade ore stockpile was 3,130 mg/kg. These concentrations compare to the U.S. Environmental Protection Agency (EPA) Regional Screening Level for mercury in Industrial Soils (310 mg/kg), and the mean background concentration of mercury near the mine (11.7 mg/kg). The highest concentration of total recoverable (TR) mercury in surface water was identified in the Blue Pond at the West Pit Area of the Site (0.82 micrograms per liter [µg/L]). TR mercury in samples collected from Little Cottonwood Creek ranged from 0.013 µg/L to 0.021 µg/L. This is compared to the Oregon Aquatic Life Criterion of 0.012 µg/L total mercury.

Table 1 provides a summary of the mercury concentrations in various media at the Site, along with applicable human and ecological regulatory standards.

Table 1: Summary of Mercury Human Health & Ecological Standards and Documented Contamination

Location	Range Mercury, Total	Average Mercury, Total	Lowest Human or Ecological Standards for Mercury	
Waste Material				
Soil Background	0.17 to 70.8 mg/kg	11.7 mg/kg	Oregon Level II Ecological Screening Level Values for Soil	0.1 mg/kg
Ore Processor	1,370 to 190,000 mg/kg	45,052 mg/kg		
Low-Grade Ore Stockpiles	3130 mg/kg	3130 mg/kg		
Ore Stockpile	168 mg/kg	168 mg/kg		
East Pit	15 to 124 mg/kg	68.92 mg/kg		
West Pit	102 to 251 mg/kg	160 mg/kg		
Surface Water				
Blue Pond	0.82 µg/L	0.82 µg/L	Oregon Aquatic Life	0.012 µg/L
Cottonwood Creek Adjacent to West Area Workings	<0.2 µg/L	<0.2 µg/L		
Confluence of Cottonwood and Little Cottonwood Creeks	0.013 to 0.021 µg/L	0.017 µg/L		
Sediment				
Cottonwood Creek	1.4 to 92.1 mg/kg	24.27 mg/kg	Oregon Level II Screening Level Values for Freshwater Sediment	0.2 mg/kg
Ore Processing Area	613 to 640 mg/kg	626 mg/kg		
Little Cottonwood Creek	0.68 to 390 mg/kg	198 mg/kg		
Middle Tributary, Little Cottonwood Cottonwood Creek	0.42 to 231 mg/kg	137 mg/kg		
East Tributary, Little Cottonwood Creek	2,330 mg/kg	2,330 mg/kg		
Fish Tissue				
Cottonwood Creek	1.7 mg/kg	1.7 mg/kg	Oregon Fish Tissue Advisory Level	0.35 mg/kg

Notes: Abbreviations: µg/L = micrograms per liter, mg/kg = milligrams per kilogram.
Bold concentrations exceed one or more human health and ecological standards.
1. See Bretz Mine EE/CA, Tables 2 through 7 for sources of human health and ecological standards

III. Soil Pathway, including Waste Rock and Ore Stockpiles

The vicinity of the Bretz Mine is arid with sparse vegetation. Large areas of the Site lack vegetation as a result of historic mining operations. These conditions lead to a high potential for exposure to mercury through direct contact with soil (ODEQ, 2001a).

Census data cited in the preliminary assessment indicates that no residents exist within 5 miles of the mine, and no residences are located in the vicinity of the Site. With no resident or other facilities in the area, potential human exposure targets are limited to occasional site visitor and workers performing mineral exploration tasks. The mine is accessible by a gravel road, and the property is not secured. The potential for direct contact with contaminated soil at the Bretz Mine is high. The exposure risk is moderated by the limited number of human receptors and the limited time that is spent by humans at the Site (ODEQ, 2001a).

Elevated concentrations of one or more hazardous substances are present in some soils in impacted areas, particularly the OPA and ore stockpiles. These areas vary in size, relative position and access, and the concentrations of hazardous substances. It is noteworthy that an unknown, but substantial, volume of waste rock and concentrator tailings have been introduced into the surface water system and transported downstream to the two upper impoundments. As noted above, waste rock within impoundment #1 contains concentrations of a range of hazardous substances. The tailings from the OPA were deposited in Little Cottonwood Creek upstream of impoundment #2.

a. Groundwater Pathway

The target distance for the groundwater pathway has been defined as 4-miles, and example targets are drinking water wells, wellhead protection areas, etc. No wellhead protection areas or water supply wells were identified within a 4-mile radius of the Bretz Mine (ODEQ, 2001a). There are six wells within a 4-mile radius of the Site. One is listed as industrial use and the others do not indicate a use. Groundwater is known to exist at between 200 to 300 feet below ground surface. Static levels remained at approximately the same depths (ODEQ, 2001a). Based on the lack of receptors and depth to groundwater, the groundwater pathway is not significant (ODEQ, 2001a). This removal will address ground water only indirectly in consideration of impounded surface water or mine wastes present at several features.

b. Surface Water Pathway

The surface water pathway in-water flow segments at the Site begin at the Probable Point of Entry (PPE) to the middle tributary in the East Mine Pit, and the PPE to Little Cottonwood Creek in the West Mine Pit.

The surface water migration pathway includes both overland segments and in-water segments. Two primary overland flow paths were identified at the Site. One path leads from the ore stockpile, approximately 144 feet southeast to the PPE to the middle tributary. The other path leads from the former OPA approximately 87 feet southeast to the PPE at the head of a drainage gully in the hillside. Since the courses of Little Cottonwood Creek and the middle tributary run directly through the West and East Mine Pits, respectively, there are no additional overland flow segments of the surface water migration pathways for these sources. As a result, PPEs associated with the East and West Mine Pits occur in those areas where the surface water body flows through the source.

The surface water pathway in-water flow segments at the Site begin at the PPE to the middle tributary in the East Mine Pit, and the PPE to Little Cottonwood Creek in the West

Mine Pit. The middle tributary includes the PPE from the ore stockpile approximately 0.09 mile south of the East Mine Pit, then flows 0.28 mile further south to join Little Cottonwood Creek. From the PPE in the West Mine Pit, Little Cottonwood Creek flow approximately 0.57 miles south where it is joined by a drainage gully that includes the PPE from the former OPA. From this point, the creek flows 0.34 miles south to the confluence with the middle tributary, then 1.32 miles further south where it joins Cottonwood Creek.

The surface water pathway in-water segment begins in two locations. The first location is where Little Cottonwood Creek enters the West Mine Pit and the second location is where the Middle Tributary enters the East Mine Pit. The farthest down slope PPE (southern drainage gully) is used to define the 15-mile target distance limit (TDL). From the PPE at the southern drainage gully, the surface water pathway extends approximately 117 feet to Little Cottonwood Creek, and then continues in Little Cottonwood Creek from approximately 1.5 miles to its confluence with Cottonwood Creek. In Cottonwood Creek it extends approximately 1.1 miles downstream to the confluence with McDermitt Creek, then 0.3 miles downstream in McDermitt Creek to the Oregon-Nevada border. In Nevada, the TDL extends approximately 5.7 miles along McDermitt Creek, at which point McDermitt Creek repeatedly branches into several distributaries. The TDL includes all these distributaries, and also extends approximately 0.4 mile along a waterway called “The Slough” which receives the flow of the northernmost tributary. The Slough is a tributary to the Quinn River.

c. Drinking Water Intakes

The PA reports no surface water rights on record with the Oregon Water Resources Department for the portions of Little Cottonwood Creek, Cottonwood Creek, and McDermitt Creek downstream of the Bretz Mine within Oregon, a distance of approximately 4 miles. The remainder of the 15 mile surface water TDL is located within Nevada and EPA Region 9 (ODEQ, 2001a). No surface water intakes were identified within the 15-mile surface water pathway TDL in Nevada.

d. Wetlands and Other Sensitive Environments

The National Wetland Inventory (NWI) Bretz Mine quadrangle map indicates that the 1.1 mile length of Cottonwood Creek downstream of the Bretz Mine is classified as polustrine scrub-shrub wetland (PSSA); therefore, wetland frontage totals 2.2 miles (NWI, 1990).

According to the Oregon Department of Fish and Wildlife, Malheur Watershed District (ODFW), the federally-listed threatened species of Lahontan cutthroat trout (*Onchorhynchus clarki henshawi*) and hybrids are present in McDermitt Creek and Indian Creek downstream of the Bretz Mine, and may be present in Cottonwood Creek during high flow periods (Bowers, 2001, 2002).

The PA identified Little Cottonwood Creek, which is present at the Site; Cottonwood Creek, one mile from the Site; and McDermitt Creek, three miles from the Site as the nearest sensitive environments. “Significant riparian vegetation” was observed at each of these creeks. McDermitt Creek and Indian Creek are also listed as 303d water quality limited streams for temperature (ODEQ, 2002).

e. Air Pathway

The sparse vegetation and disturbed soil at the Bretz Mine leads to high potential for exposure to mercury contamination by windblown dust and mercury vapors emanating from ore and other mercury-containing materials on the Site (ODEQ, 2001a).

As mentioned in the soil exposure pathway section, human targets in the area are limited essentially to occasional visitors and mineral prospectors, both of which are expected to be in the area for limited periods of time.

f. Summary of Human Health Risks

Based on current and future land use, recreational users (e.g., hunters, off-highway vehicle users, and prospectors) were considered the most probable receptors at the Site. Three metals (antimony, mercury, and thallium) were identified as COPCs in surface soil. Arsenic and mercury were identified as COPCs in sediment, and arsenic, cobalt, iron, thallium, vanadium and zinc were identified as COPCs in surface water. Three of these constituents (iron, thallium, zinc) were identified as COPCs only because no screening criteria were available.

No unacceptable carcinogenic health risks were predicted due to arsenic or cobalt, which were the only carcinogenic COPCs identified at the Site.

No unacceptable non-carcinogenic health risks were predicted from COPCs in sediment and surface water. Mercury in soil was the only COPC which exceeded the regulatory standard for non-carcinogens. Ingestion of soil under both the CTE and RME exposure conditions exceeded the regulatory standard of HI – 1 with HIs ranging from 4.4 (CTE) to 32.6 (RME).

A cleanup goal of 1,640 mg/kg (based on the CTE) was calculated for mercury in soil. Based on the definition of hotspots for non-carcinogens, soil samples were screened against the hotspot concentration of 1,640 mg/kg. Six hotspots were identified in the OPA and no hotspots were identified in the stockpiles.

g. Summary of Ecological Risks

Elevated concentrations of several COPECs were exhibited in multiple sample locations in ore processor soils, stockpile soils, surface water, and sediment at the Site. The most significant risk is predicted to be posed to plants and terrestrial invertebrates that inhabit the OPA and stockpiles.

Given the magnitude of the risk ratios and the number of sample locations where concentrations exceeded ERBSCs, the metals of most concern in soil include antimony, chromium, and mercury. The only metal of concern in surface water is cadmium. Metals of concern in sediment include antimony, arsenic, cadmium, mercury, and selenium. Mercury has the highest and most widespread predicted ecological risks across the exposure media. Hot spot concentrations were identified for several COPECs, particularly in soil and sediment.

IV. Overview of the Human and Ecological Risk Assessment

The risk assessment indicated there are no unacceptable human health risks from exposure to sediment and surface water. Ingestion of mercury in soil under both CTE and RME exposure conditions demonstrated a potential for unacceptable non-cancer human health impacts. A hotspot analysis determined there are six human health related hotspots at the Site, all located in the OPA. A cleanup goal of 1,640 mg/kg was calculated for the Site soils. Removal or capping of material exceeding the cleanup goal would eliminate some potential pathways of exposure and therefore reduce intakes and potential adverse health impacts.

In the ERA, ecological impacts were predicted for multiple species due to COPECs in multiple exposure media near, or associated with, the OPA. Risks were highest in soil and sediment and considerably lower for aquatic life due to COPECs in surface water. Given the intermittent flow of water in Little Cottonwood Creek and its tributaries, any risks to aquatic life would be limited to invertebrates. Overall, sessile or resident species inhabiting terrestrial and sediment habitats are the species most likely to be impacted by Site contamination.

Prostrate buckwheat is a relatively rare (but not threatened or endangered) plant in the Site vicinity that could be impacted if present in areas of elevated COPEC concentrations. Sage grouse are another rare species in the Site vicinity, but unlike plants, these birds exhibit relatively large home range areas. Therefore, exposure of COPECs at the Site would likely be limited. Further species-specific ecological assessment would be required to more accurately assess the potential for the predicted bird and mammal direct and indirect (e.g. bioaccumulation) risks to be realized.

The existing ecological assessments completed at Bretz Mine were used in removal action planning to select the most cost-effective approach. Remediation, removal, or reduced receptor exposure to COPECs in soil and sediment would be necessary to adequately reduce the predicted impacts to ecological receptors. The mercury cleanup goal of 1,640 mg/kg recommended to reduce human health risks is also expected to reduce ecological impacts to terrestrial wildlife and plant species.

V. IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The goal of a Removal Action is to protect human health and the environment by preventing, controlling or minimizing the release or potential release of a hazardous substance, and reducing the potential for direct contact and transport of hazardous substances to the environment. Based on the information presented in this EE/CA, the following Removal Action Objectives (RAOs) were developed for the Site:

- Reduce the human and ecological exposure to hazardous substances in the mining-related waste, stockpiles, and the associated contaminated soils.
- Minimize or eliminate potential for hazardous substance mobilization and transport from contaminated materials at the Site by stabilizing and/or covering waste sources.
- Improve surface water and sediment quality downstream of the Site in Cottonwood Creek by decreasing hazardous substance loading from on-site waste sources.

The following sections discuss the Removal Action justification, scope, and the proposed schedule.

a. Removal Action Justification

The Removal Action is undertaken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or the threat of a release at a site. Section 300.415(b)(2) of the NCP outlines eight factors to be considered when determining the appropriateness of a Removal Action. The applicable factors are outlined in Table 2: Removal Action Justification presented below and within the EE/CA and provide justification for undertaking Removal Action.

Table 2: Removal Action Justification

Factor	Site Summary	Justification
(1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants	Complete exposure pathways to human (recreational) and ecological receptors (aquatic and terrestrial) were documented during previous investigations from exposure to mercury-impacted waste material, and stream sediment.	**Yes**
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	Recreational visitors do not likely use local streams as a drinking water source. In addition, the groundwater pathway is incomplete; therefore, impacts to drinking water supplies are not expected. However, the local floodplain and riparian areas downstream from the Site and associated ecological receptors are likely impacted by the erosion of waste material.	**Yes**
(3) Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release	No drums, barrels, tanks, or other bulk storage containers were observed at the Site. In other areas of the mine, some old empty drums are scattered in various locations.	**Yes**
(4) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate	Surficial waste material is contaminated with mercury and other metals. These hazardous substances are susceptible to chemical mobilization and transport by snow melt thunderstorms.	**Yes**
(5) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released	Although total precipitation is low, high runoff conditions could occur in spring, or during severe thunderstorms, which could erode and transport waste materials within the floodplains.	**Yes**
(6) Threat of fire or explosion	No known fire or explosion threats are present at the Site.	**No**
(7) The availability of other appropriate federal or state mechanisms to respond to the release	The Site is owned and administered by the BLM and is not currently listed or proposed for listing on the National Priorities List. Thus, the BLM is the agency with CERCLA authority at the Site	**Yes**
(8) Other situations or factors that may pose threats to public health or welfare of the United States or the environment.	The Site is located in a remote area of the Vale District, with difficult access. A shaft and adit were reported within a mile of the Site. In addition, the mine area has steep pit walls that pose physical hazards for on-site receptors.	**Yes**

b. Identification and Screening of Removal Action Options and Alternatives

The purpose of identifying and screening technology types and processes is to eliminate those technologies and process options that are unfeasible and/or do not meet potential key ARARs.

General Removal Actions are refined into technology types and process options. This removal considers options for addressing impacted soils/wastes at the Site.

The technology and process options are screened for Removal Action on impacted soil/waste material at the Site. Although many treatment technologies and process options have been evaluated for mine/mill waste, most of these are not considered feasible. These technologies involve a variety of techniques related to physical/chemical processes. At present, most of these technologies would require extensive treatability studies, are not applicable to the Site, require unavailable infrastructure (power, access), or incur excessive costs to benefit received, and thus are not considered appropriate. Therefore, the screening process has evaluated a limited number of treatment technologies. Technologies and processes considered for impacted soils and solid wastes include the following:

- Access Restrictions
- Engineering Controls
    - Source Containment/Control
    - Surface Controls
- Land Disposal
- Treatment

VI. Alternatives

This section provides a summary of the general alternatives considered for the Site. These alternatives were considered within the framework of achieving selected RAOs.

- Alternative 1: No Action
- Alternative 2: Institutional Controls
- Alternative 3: Onsite Containment
- Alternative 4: Removal and Disposal in an On-Site Repository
- Alternative 5: Removal and Off-Site Disposal

Alternative 1 - No Action

No Removal Action would be completed to control hazardous substance migration or reduce the toxicity or volume. This alternative is used as baseline against which other removal options can be compared as suggested by the NCP.

Alternative 2 - Institutional Controls

This alternative includes installing additional fencing and signage, as well as road decommissioning as outlined below. This will incur relatively minor costs and may reduce human exposure and risk. However, it will provide limited to no reduction in risk to the ecological receptors. This alternative assumes little or no road improvement will be necessary. This alternative also assumes that fencing would remain undamaged by human interference.

a. Removal Action Elements Common to Alternatives 3, 4, and 5

Building Material, Equipment, and Debris Demolition / Disposal

All metal, wood, equipment, and other miscellaneous nuisance debris that pose a potential physical or chemical hazard to Site users will be removed from the Site. To the extent possible and practicable, historic features will be left intact; waste material above the cleanup concentration will be removed using hand tools to reduce the potential disturbance caused by using mechanized equipment. The EE/CA estimates that 20 cy of demolitions debris material will be disposed offsite at a Subtitle D Landfill (i.e., Humboldt County Landfill in Winnemucca, Nevada).

An asbestos survey was completed for remnant structures at the Site by an EPA-Certified Asbestos hazard Emergency Response Act (AHERA) inspector. Building materials identified with asbestos-containing material (ACM) will be will be kept in non-friable condition and removed under the supervision of an ODEQ-licensed asbestos contractor during the RA. Handling, transport, and disposal will require treatment of suspect ACM that prevents it from becoming friable. The material will be transported to a landfill permitted to accept asbestos waste. The landfill will be notified in advance the material is considered suspect ACM.

Road Access, Maintenance, and Decommissioning

The access road to the Site will need to be upgraded to implement the Removal Action. As such, the existing road system around the ore Processor and low-grade ore stockpile would be improved for equipment access.

During the Removal Action, water will be applied as needed to control fugitive emissions. Water for dust control will be withdrawn from Cottonwood Creek (if available) and/or the Blue Pond, with appropriate cautions taken to withdraw water from designated fire water withdraw points and fish screens on intake hoses. Upon completion of the Removal Action activities, roads within the limits of the Site and other access roads specifically constructed for the Removal Action will be decommissioned. Decommissioning will consist of re-contouring the road for proper drainage, ripping to 6-inches, seeding, and mulching. An estimated a total of 2,500 lineal feet of roads are to be decommissioned. Following decommissioning, the roads will be contoured to limit unauthorized vehicle access. Existing roads for access through and beyond the Bretz Mine will remain intake for Public access.

Re-vegetation and Erosion Control

All disturbed areas, excavation areas, covered waste material, and the repository (Alternative 3, 4 and 5) will be re-vegetated with the application of seed, fertilizer, and mulch. Seed mix will consist of the following, based on the BLM Rehabilitation Seed Mixture developed during the Environmental Assessment for the Site (BLM, 2009):

- Bluebunch wheatgrass (16 lbs/acre)
- Bottlebrush squirreltail (8 lbs/acre)
- Sandberg’s bluegrass (4 lbs/acre)
- Thurber’s needlegrass (8 lbs/acre)

Fertilizer will consist of 16% total nitrogen, 16% available phosphoric acid, 16% total water soluble potash, and 5% sulfur applied at the rate of 400 pounds per acre. Certified weed-free mulch would be applied at 70% coverage to control erosion during plant establishment.

Storm water and snowmelt run-on are not expected to be a significant factor during the RA. However, if surface water becomes an issue due to severe thunderstorms or high snow melt, it would be controlled on the up-gradient side by constructing run-on control berms. These will be incorporated into the grading activities so separate run-on ditches will not be required.

Engineering Controls

Engineering controls for surface water diversion and physical hazards are outside the scope of this RA. Physical hazard remediation on the remainder of the Bretz Mine, such as the shaft, adit, and vertical pit walls, will be addressed by the BLM as part of future physical hazard remediation activities as warranted.

Alternative 3 – Onsite Containment

This alternative incorporates covering of mercury-impacted materials at the Site that exceeds the cleanup concentration of 1,640 mg/kg. Based on the results of previous investigations completed at the Site, the primary area with mercury-contaminated soil in excess of the cleanup standard is located adjacent to the D- tube retorts and mill foundation. Mercury-contaminated material in excess of the cleanup standard was also identified in a low-grade ore stockpile (sample BROS03).

Under this alternative, clean soil will need to be obtained to cover the lateral extent of mercury-contaminated material. The estimated lateral extent of mercury-contaminated media at the OPA in excess of the calculated cleanup level is about 0.23 acres (10,000 square feet). Thus, approximately 370 cy of cover material would be required to create a one-foot cover over the contaminated areas around the retorts and mill foundation. The lateral extent of mercury-contaminated material in the low-grade ore stockpile in excess of the cleanup standard is unknown. Preliminary field estimates indicate the pile may be about 80,000 cy in size. Further assessment would be required to refine this estimate. For the purposes of budgeting, it is assumed 2,000 cy of cover material would be required to cap the areas with the highest concentrations of total mercury in the low- grade ore stockpile in place.

All disturbed areas and re-graded areas will be re-contoured to blend with surrounding topography and re-vegetated with native seed. Mercury-impacted soils would be re-graded to blend into the surrounding terrain. Following re-contouring, at least one-foot of clean material (6-inch equipment compacted lift and 6-inch loose lift) from the nearby borrow source would be placed on the impacted areas.

Alternative 4 - Removal and Disposal in an On-Site Repository

Under this alternative, all waste material that exceeded the proposed total mercury cleanup concentration of 1,640 mg/kg will be excavated and consolidated in a centralized repository. At an assumed excavation depth of 3 feet, the maximum volume of material to be removed and consolidated from the OPA is estimated at 370 bcy. The volume of material in excess of the cleanup standard at the low-grade ore stockpile is unknown and should be assessed further. However, the approximate volume of the pile is estimated at 80,000 bcy. The size of the pile will need to be further delineated to identify the areas with the highest concentration for removal. For the purposes of estimating, it is assumed about 10,000 bcy of the most contaminated material would need to be removed and consolidated.

Visual observations and an XRF will be used to delineate the extent of the excavations and confirmation samples will be collected and sent to the laboratory to document the removal. The preferred repository location is in the Lake Bed Deposit Formation west of the OPA. Background sample S-3BK was collected from the formation and exhibited low metals concentrations. As such, suitable cover material should be available from this area. The approximate round-trip haul route is 2 miles on BLM roads from the OPA and 2.5 miles from the low grade ore stockpile. The Lake Bed Formation provides relatively flat terrain to contain the material.

The volume of cover soil and topsoil needed for the proposed repository (~ 1 acre) is approximately 1,700 cy. Storm water and snowmelt run-on would be controlled on the up gradient side by constructing run-on control berms; these will be incorporated into the grading activities so separate run-on ditches will not be required. The repository cap would be covered with weed-free wood mulch, seeded, and fertilized. Excavated areas will be re-contoured to blend into the surrounding contours. All disturbed areas (~2 acres) would be re-contoured and re-vegetated to approximate original topography. Certified weed free mulch would be applied to control erosion during plant establishment.

Alternative 5 - Removal and Off-Site Disposal

Under this alternative, all waste material that exceeds the proposed total mercury cleanup concentration of 1,640 mg/kg will be excavated and transported to a RCRA Subtitle C Landfill. The maximum volume of material to be removed and consolidated from the OPA is estimated at 370 bcy. The volume of material in excess of the cleanup standard at the low-grade ore stockpile is unknown and should be assessed further. However, the approximate volume of the pile is estimated at 80,000 cy. The size of the pile will need to be further delineated to identify the areas with the highest concentration for removal. For the purposes of estimating, it is assumed about 10,000 cy of the most contaminated material would need to be removed and consolidated. This alternative is considered protective of human and ecological receptors; because all waste material with mercury concentrations greater than the proposed cleanup concentrations would be removed and disposed off-Site. None of the waste material has been documented to exceed RCRA TCLP limits, however; based on the high concentrations of total mercury near the OPA, some of the material could be considered a Dangerous Waste. However, due to the nature of the material as mining waste, it has been determined that for this alternative, the material be disposed of in a Subtitle C landfill. The nearest landfill for Subtitle C (hazardous) solid wastes is the ChemWaste facility located in Arlington, OR. Materials would be trucked to the appropriate facility (round trip haul ~ 775 miles).

Excavated areas will be re-contoured to blend into the surrounding contours. Visual observations and a Niton XRF will be used to delineate the extent of the excavations; confirmation samples will be collected and sent to the laboratory to document the removal. All disturbed areas (~1 acre) would be recontoured and revegetated. Certified weed free mulch would be applied to control erosion during plant establishment. Storm water and snowmelt run-on would be controlled on the up gradient side by constructing run-on control berms; these will be incorporated into the grading activities so separate run-on ditches will not be required.

VII. Analysis of Selected Removal Action Alternatives

As required by the CERCLA guidance (USEPA, 1993) and the NCP (40 CFR 300.415), Removal Action alternatives retained after the initial evaluation and screening have been evaluated individually against the following three criteria (effectiveness, implementability, and cost) and listed sub-criteria).

- **Effectiveness**
  - Compliance with Removal Action goals and objectives
  - Overall protection of human health and the environment
  - Compliance with potential ARARs
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness
- **Implementability**
  - Administrative feasibility
  - Technical feasibility
  - Availability of services and materials
  - State and community acceptance
- **Cost**
  - Direct capital costs
  - Indirect capital costs
  - Annual maintenance and inspection costs

Evaluation of costs consists of developing estimates (±30%) based on the description of work items developed for each Removal Action alternative. These costs do not necessarily represent those that may be incurred during construction of the alternative, because many design details are preliminary at this stage. However, a similar set of assumptions is used for all the alternatives, so that the *relative* difference in cost between alternatives can be considered.

The 20 year Net Present Value (NPV) of each of the alternatives costs are presented below, from least to most expensive:

Alternative (NPV)	Estimated Cost
Alternative 1 – No Action	$0
Alternative 2 – Institutional Controls	$59,000
Alternative 3 – Onsite Containment	$291,000
Alternative 4 – Excavation and Onsite Containment in Repository	$464,000
Alternative 5 – Excavation and Offsite Disposal	$1,981,000

a. COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The effectiveness of the retained alternatives was evaluated based on advantages in each of the evaluation criteria, as well as the removal action goals and objectives.

Effectiveness of Alternatives

- Alternative 1 – No Action.
  - This is the least effective alternative. It would provide no reduction of toxicity, mobility, or volume, waste material would continue to pose a risk to public visitors and to ecological receptors, and it would not comply with potential ARARs or achieve the RAOs.
- Alternative 2 – Institutional Controls.
  - This alternative has low effectiveness, as it would provide no reduction of toxicity, mobility, or volume. Despite signage, waste material would continue to pose a risk to public visitors and to ecological receptors.
  - It would not comply with potential chemical-specific ARARs and proposed cleanup goals, or achieve the RAOs.
- Alternative 3 – Onsite Containment.
  - This alternative is more effective than Alternatives 1 and 2 by isolating exposure to human receptors, but there would only be a reduction in exposure to terrestrial ecological receptors, as material could continue to erode into the gully leading to and directly into Little Cottonwood Creek.
  - It would not comply with all potential chemical-specific ARARs, but does achieve the RAOs.
- Alternative 4 – Removal and Disposal in an On-Site Repository.
  - This alternative provides higher effectiveness than Alternatives 2 and 3 by removing hazardous substances from the OPA and low-grade ore stockpile and disposal in a controlled facility at the Site.
  - It provides greater reduction of the mobility of hazardous substances and more effective protection for human health, ecological receptors, and the environment than Alternatives 2 and 3 (due to removal and consolidation of mine waste in a repository), but it is less effective than Alternative 5.
  - It provides the most effective compliance with chemical-specific potential ARARs and the proposed cleanup goals as compared with MW Alternatives 2 and 3, and similar to Alternative 5. RAOs are achieved.
- Alternative 5 – Removal and Off-Site Disposal.
  - This alternative provides the most effective reduction of the mobility of hazardous substances and thus the most effective protection to human health, ecological receptors and the environment compared with the other alternatives by removing hazardous substances from the Ore Processor and low-grade ore stockpiles to an off-Site disposal facility.

    - It provides the most effective compliance with chemical-specific potential ARARs and the proposed cleanup goals as compared with Alternatives 2 and 3, and similar to Alternative 4. RAOs are achieved.
    - Long-term effects would be more beneficial than Alternatives 2 and 3, and similar to Alternative 4.

Implementability of Alternatives

- Alternative 1 – No Action.
    - This alternative is the most technically feasible and is easiest to implement.
- Alternative 2 – Institutional Controls.
    - This alternative is technically and administratively feasible and easy to implement compared to Alternatives 3, 4, and 5.
- Alternative 3 – Onsite Containment.
    - This alternative is technically feasible to implement due to Site access and availability of cover soil material.
    - Administrative feasibility is more difficult to implement than Alternatives 1 and 2, but it is similar to Alternatives 4 and 5.
- Alternative 4 – Removal and Disposal in an On-Site Repository.
    - Alternatives 4 and 5 are technically and administratively feasible, but are the most difficult to implement.
    - Removal equipment is greater than what is required under Alternatives 2 and 3, but less than Alternative 5 (e.g., off-Site transport).
- Alternative 5 – Removal and Off-Site Disposal.
    - Alternatives 4 and 5 are technically and administratively feasible but the most difficult to implement.
    - Necessary equipment and supplies are least available for this alternative because of the distant location of the disposal facility.

Cost of Alternatives

- Alternative 1 – No Action.
    - No cost alternative.
- Alternative 2 – Institutional Controls.
    - Total cost is lower than other action alternatives.
    - Higher operating and maintenance costs (O&M) than Alternatives 4 and 5, but less than Alternative 3. Higher O&M related to ongoing annual monitoring of the mine waste and surrounding aquatic resources.
- Alternative 3 – Onsite Containment.
    - Total cost higher than Alternative 2, but less than Alternatives 4 and 5.
    - High O&M costs due to ongoing annual monitoring of the mine waste and surrounding aquatic resources.
- Alternative 4 – Removal and Disposal in an Onsite Repository.

    - Relatively high cost action alternative, second highest of the alternatives.
    - This alternative has lower O&M costs than Alternative 2 and 3, but higher than Alternative 5. O&M cost associated with annual inspection and sampling at the Repository.
- Alternative 5 – Removal and Off-Site Disposal.
    - This is the highest cost action alternative.
    - This alternative has the lower O&M costs than Alternatives 2, 3, and 4.

VIII. RECOMMENDED REMOVAL ACTION

The recommended Removal Action is discussed in this section. The action recommended for the Site is based on the appropriate combination of alternatives to best achieve the RAOs. My decision is based on the information outlined in the EE\CA and Data Gap Analysis.

A combination of Alternatives 3, Onsite Containment, and Alternative 4, Removal and Disposal in an Onsite Repository, is selected as the preferred alternative for the Site remediation. The budgeted cost of the Removal Action is $462,000.

The remediation work will be accomplished under a design-build contract including pre-excavation survey, soil characterization, repository design and construction, improvement of site access roads, asbestos removal and disposal, mercury contaminated soils remediation, fall hazard reduction, well capping and site restoration/reclamation. The repository will be constructed at the OPA allowing the mercury processing equipment to shift into the excavation with negligible transport distance. Mercury contaminated materials that exceed the cleanup concentration of 1640 mg/kg will be excavated and consolidated, along with the processing equipment, in the centralized repository. The completed repository will be capped with compacted local soil and rock material, contoured to allow precipitation drainage, and re-vegetated with the native seed mixture listed in the EE/CA. Removal and disposal of ACM debris from the OPA willed be transported offsite for disposal at an approved disposal facility. ACM to be removed from the site consists of asbestos containing gaskets and cement asbestos piping (transite).

This combination of alternatives was chosen as the most cost-effective method of isolating the contaminated soils at the OPA from exposure to weather events and human interaction. Costs are reduced by minimizing the transportation of contaminated equipment and soils to another area of the mine.

Donald Gonzalez
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Vale District BLM